

in the last days of December 1885—December 19, 5^h 86 m.; December 20, 5^h 76 m.; December 30, 6^h 00. Profs. Glasenapp and Pritchard both found it considerably fainter than the 6th at this time, the former giving it as 6^h 7 m. on December 30, the latter 6^h 42 m. on December 23. Profs. Müller and Pritchard give closely accordant results for the middle of January 1886, the magnitude being about 6^h 8 m., whilst Prof. Glasenapp and Mr. Gore found it about 7^h 3 m. at the same time. Profs. Pritchard and Müller disagree a little later on, and differ by a full magnitude at the end of February and beginning of March, the former regarding the star as about the 7th magnitude, the latter about the 8th, whilst MM. Glasenapp and Gore consider it as nearly the 9th. There is a better agreement amongst three of the observers as to the range of magnitude through which the star has passed; Dr. Müller and Mr. Gore, agreeing in giving 2^h 4 m. for the change from about December 20 to March 8, and Prof. Glasenapp finding nearly the same value, but Prof. Pritchard, on the other hand, only finds a change in the same period of about seven-tenths of a magnitude.

IO SAGITTÆ.—Mr. Espin, in *Circular* No. 5 of the Liverpool Astronomical Society, gives the interval from maximum to minimum for this star as 4^h 4d.; maxima for July, 1^h 6d., 9^h 9d., 18^h 3d., 26^h 6d.; minima 6^h 1d., 14^h 4d., 22^h 7d., 31^h 0d.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 JULY 4-10

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on July 4

Sun rises, 3h. 52m.; souths, 12h. 4m. 6^h 4s.; sets, 20h. 16m.; decl. on meridian, 22° 53' N.; Sidereal Time at Sunset, 15h. 7m.

Moon (three days after New) rises, 7h. 7m.; souths, 14h. 36m.; sets, 21h. 53m.; decl. on meridian, 13° 19' N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian
Mercury ...	5 42	13 39	21 36	20 33 N.
Venus ...	1 36	9 24	17 12	19 13 N.
Mars ...	11 14	17 16	23 18	0 23 S.
Jupiter ...	10 53	17 6	23 19	1 44 N.
Saturn ...	3 53	12 2	20 11	22 30 N.

July	h.	
4 ...	2 ...	Saturn in conjunction with the Sun.
7 ...	7 ...	Jupiter in conjunction with and 0° 33' south of the Moon.
7 ...	13 ...	Mars in conjunction with and 2° 1' south of the Moon.

Variable Stars

Star	R.A. h. m.	Decl. ° ' N.	July	h. m.
U Cephei ...	0 52 ²	81 16	July 4,	0 33 <i>m</i>
Algol ...	3 0 ⁸	40 31	" 9,	0 13 <i>m</i>
R Bootis ...	14 32 ²	27 14	" 8,	3 16 <i>m</i>
δ Libræ ...	14 54 ⁹	8 4	" 10,	22 40 <i>m</i>
U Coronæ ...	15 13 ⁶	32 4	" 8,	2 57 <i>m</i>
S Herculis ...	16 46 ⁷	15 8	" 4,	<i>m</i>
R Ophiuchi ...	17 1 ²	15 56	" 4,	<i>M</i>
U Ophiuchi ...	17 10 ⁸	1 20	" 7,	0 40 <i>m</i>
X Sagittarii ...	17 40 ⁴	27 47	" 10,	2 0 <i>M</i>
β Lyræ ...	18 45 ⁹	33 14	" 9,	21 30 <i>M</i>

M signifies maximum; *m* minimum.

NATIONAL SMOKE ABATEMENT INSTITUTION¹

DURING the year the interest in the subject of smoke prevention and in improved apparatus for the consumption of fuel has been steadily increasing, and the gradual extension of knowledge on the subject has led the general public to take a much more intelligent and active interest in the question of smoke abatement, which was at first considered by the great majority of the community to be almost a sentimental evil rather than a matter entering into the calculation and care of ordinary

¹ Report of Council of the National Smoke Abatement Institution, submitted at the ordinary general meeting, December 18, 1885.

life. The Council regret, however, to note that the Annual Report of the Commissioner of Police, issued in August last, is strangely deficient with regard to information as to the operation of the Metropolitan Smoke Abatement Acts, which are administered by the police; and the Council thought it their duty to write to the *Times* and other daily papers, calling attention to this want of information in the Report, and also to the very anomalous character of the fines inflicted in the case of convictions; they also laid the matter before the Home Secretary, calling special attention to the following facts—

(1) That in numerous cases of nuisance which are reported by the police no proceedings are taken.

(2) That when proceedings are instituted, and convictions obtained, the penalties inflicted by the magistrates do not comply with the Acts of 1853-56, the average fine being below the legal minimum.

(3) That no proceedings whatever appear to be taken to enforce the abatement of smoke from steamers, &c., on the River Thames, although an enormous quantity of smoke is evolved by them, causing a very serious nuisance, not only in the waterside districts, but by polluting the general atmosphere of the metropolis.

(4) That such great development has taken place during the last few years in the methods of preventing smoke from the works falling under the provisions of the statutes, that they may be more rigidly enforced without hardship.

(5) That the area within which the Smoke Abatement Acts apply no longer corresponds with the area within which smoke is produced.

The Council were supported in thus calling the attention of the Home Secretary to the matter, by the fact that the Annual Report of the Commissioner of Police for the preceding year (1883) remarks strongly on the inadequacy of the fines, and states that, "The fact of recent changes in heating systems having brought about some very considerable commercial advantages of various kinds, has operated in a marked degree in mitigating hostility to the enforcement of the Acts."

The Council have also, through the medium of the Press, called attention to the fact that the London School Board are neglecting a public duty and losing a valuable opportunity of instructing the public, by having the large buildings recently erected for schools fitted up with heating apparatus without due regard to their smoke-consuming capabilities.

They have also endeavoured to influence public opinion by bringing under notice pledges which appear to have been given by some Parliamentary candidates, that they would endeavour to exempt bakers from the operation of the Smoke Abatement Acts, this pledge having been obtained by certain bakers who wished to maintain the use of a particular class of furnaces which ordinarily produce a large amount of smoke. It is scarcely necessary to point out that the exemption of bakers from the operation of the Smoke Nuisance Acts would be prejudicial to the public interest, as it is a fact that smoke can be and is in some bakeries entirely prevented, not only to the advantage of the public, but also to that of the men who work in the bakeries. The Parliamentary candidates themselves were also communicated with upon the subject.

The unreasonableness of the suggestion that bakers should be exempt from the provisions of the Smoke Acts is the more noticeable from the fact that the Commissioner of Police, in his Annual Report for 1883, alluding to the general improvement of heating methods, says: "The most important changes perhaps have been made in the case of bakers' and confectioners' oven furnaces, which have hitherto caused, and still continue to cause, the greatest number of offences charged under the Smoke Acts. Some of them are now adapted by a simple alteration, which can be made without stoppage of the daily trade, to the use of gaseous fuel (ordinary coal gas mixed with atmospheric air), instead of coal; while other ovens are heated by coke applied either directly to the purpose, or by steam, which is generated in pipes heated by means of coke-fired furnaces."

It may be added that the Council have had before them an offer from a good firm of oven builders, stating that they are prepared to fit up fifty bakers' ovens at half price, to prove the practical working of one system rendering such ovens entirely smokeless.

In various trades, notably baking confectionery, tile and porcelain burning, glass staining, japanning, &c., considerable advantages, in addition to the prevention of smoke, have been found to result from the use of coal gas instead of solid fuel for

furnaces and engines, but to obtain the same result the cost of gas is greater than that of coal. Although the directors of the gas companies of the Metropolis are apparently not unwilling to advance the cause of smoke abatement, and thereby of public sanitation, by making a reduction in the price of gas used for trade purposes, they are prevented doing so by their Acts of Parliament. The Council are keeping the matter in view, and watching a favourable opportunity to urge the Government to grant the necessary powers.

Correspondence has been carried on on the subject of the gas stoves at the Bank of England, insisting on the necessity of flues being provided to carry off the products of combustion from all gas stoves used for warming purposes, and letters have been received thanking the Institution on behalf of the clerks for calling the attention of the Bank authorities to the matter. Voluminous correspondence has also been carried on with makers and inventors of stoves and smoke-prevention appliances, and of patent fuels, and with others, giving information and suggestions on points connected with the subject too various to be set out.

During the year several tests have been carried out by the Institution, and they have now under consideration the preparation of another volume of detailed reports of tests. The volume would include tests of various forms of furnaces, steam and other boilers, blow-pipe furnaces, smoke-preventing appliances, ventilating fans, non-conducting compositions, mechanical stokers, condensers, gas cooking and heating stoves, and various heating and cooking appliances using gas and coal as fuel.

The Council had at one time intended to exhibit at the Parkes Museum typical forms of heating and smoke-abatement appliances, but for various reasons they considered it undesirable to carry out the scheme, and they propose instead to promote periodical exhibitions of special heating apparatus, or new methods of heating and smoke prevention, as opportunity may offer.

In connection with this branch of the subject, reference may be made to the exhibition of the Sanitary Institute held at Leicester in September, at which various stoves and smoke-preventing appliances were exhibited. Exhibitions of gas stoves for heating and cooking purposes have also been held in many of the chief provincial towns during the year.

A memorial, praying for a grant from the surplus funds of the International Health Exhibition, signed by the Duke of Westminster and other influential persons, was unavailing, although the object of this Institution so directly affects public health, the improvement of which was the avowed aim of the Health Exhibition. This is much to be regretted, as the lack of funds not only militated against the general operations of the Institution, but it prevented the Council establishing a testing department, which is a necessary adjunct to the Institution for the advancement of its objects.

During the year a lecture given in the Parkes Museum by Mr. T. Fletcher, of Warrington, on Smoke Abatement, and a pamphlet containing three prize essays on the same subject, have been printed by the Institution and circulated. A paper by Mr. W. R. E. Coles, on the Hygienic, Moral, and Economic Aspects of the Smoke Question, read at the Leicester Congress of the Sanitary Institute, is now being prepared for circulation.

By order, E. WHITE WALLIS,
Secretary

THE WINGS OF BIRDS¹

THE power of flying through the air is one of the principal characteristics of the class of birds. Although some members of the other great divisions of the Vertebrates—the bats among Mammals, the extinct pterodactyle among Reptiles, the flying-fishes among Pisces—possess this power in a greater or less degree, these are all exceptional forms, whereas in birds the faculty of flight is the rule, its absence the exception. Among Invertebrates this power is possessed in a very complete degree by the greater number of insects.

In the normal structure of the vertebrate animals there are two pairs of limbs, anterior and posterior, never more. It often happens, however, that one pair, and sometimes both, are suppressed, being rudimentary, functionless, or entirely absent. Flight is always performed by the anterior or pectoral pair, more or less modified for the purpose. The super-addition of

wings to arms, as in the pictorial representations of angels, has no counterpart in nature. The wings of the bird, the bat, the pterodactyle, and flying-fish, are the homologues of the arms of man, the fore-legs of beasts. In the flying-fish the power is gained simply by an enlargement of the pectoral fin, and the function is very imperfect; in the pterodactyle, by immense elongation of one (the outer) finger, and extension of the skin between it and the side of the body; in the bats, by elongation of the four outer fingers, and extension of a web of skin between them and the body. In the bird the flying organ is constructed mainly of lepidermic structures, peculiar outgrowths from the surface, called *feathers*—modifications of the same tissue which constitutes the hair, horns, scales, or nails of other animals. Feathers are met with only in birds, and are found in all the existing members of the class, constituting the general covering of the surface of the body.

The framework to which the broad expanse formed by the feathers is attached is composed of bones, essentially resembling those of the fore-limb of other Vertebrates. The distal segment, manus, or hand, in the vast majority of birds, has three metacarpal bones and digits, the former being more or less united together in the adult state. The digits appear to correspond with the pollex, index, and medius of the typical pentadactyle manus; the second is always the longest. Both it and the pollex frequently bear small horny claws at their extremity, concealed among the feathers and functionless, but very significant in relation to the probable original condition of the avian wing. These claws are altogether distinct from the large, and often functional, spurs developed in many species from the edge of the metacarpal bones, resembling both in use and situation the corresponding weapons in the hind-feet. The third digit does not bear a second phalanx or claw in any existing bird.

The quills, remiges, or flight-feathers attached to the bones of the manus (called "primaries"), never exceed twelve in number, and are (as has been recently shown by Mr. Wray) in the very great majority of birds distributed as follows:—Six, or in some few cases (flamingo, storks, grebes, &c.), seven to the metacarpus; of the remainder or digital feathers, one (*ad-digital*) is attached close to the metacarpophalangeal articulation, and rests on the phalanx of the third digit; two (*mid-digital*) have their bases attached to the broad dorsal surface of the basal phalanx of the second digit, which is grooved to receive them; the remainder (*præ-digital*) are attached to the second phalanx of the same digit. These last vary greatly in development, in fact their variations constitute the most important structural differences of the wing. In most birds there are two; the proximal one well developed, the distal always rudimentary; but the former may show every degree of shortening, until it becomes quite rudimentary, or even altogether absent, as in *Fringillidae* and other "nine-primaried" birds, in which there are six metacarpal remiges, one *ad-digital*, two *mid-digital*, and no *præ-digital*s, or only a very rudimentary one. The smaller feathers at the base of the quills, called upper and under coverts, have an equally regular arrangement. The webs or vanes of all the flight-feathers are made up of a series of parallel "barbs" which cohere together by means of minute hooklets, and so present a continuous, solid, resisting surface to the air.

Such is the characteristic structure of the wing in almost all carinate birds, whether powerfully developed for flight, as in the eagles, albatrosses, or swifts, or whether reduced in size and power to practically useless organs, as in the extinct great auk, the dodo and its kindred, weka rail, notornis, cnemiornis, &c., most of which, being inhabitants of islands containing no destructive land mammals, appear to have lost the principal inducement, and with it the power, to fly.

In the penguins (*Spheniscomorpha*) the feathery covering of the wing entirely departs from the normal type. Each feather is like a flattened scale frayed out at the edges, the barbs are non-coherent and have no hooklets. They form an imbricated covering of both surfaces of the wing, including the broad patagium which extends from the cubital side of the limb, but appear to have no definite relation to the bones, and cannot be divided into distinct groups, corresponding to those described above. The structure of the wing separates the penguins sharply from all the other carinate birds.

The Ratitæ, or birds without keel to the sternum, form another very distinct group, distinguished by the rudimentary or imperfect condition of the remiges or quills, which never have coherent barbs, and are therefore unfitted for the purpose of flight. In the ostrich and rhea the bones, though comparatively

¹ Abstract of Lecture by Prof. W. H. Flower, LL.D., F.R.S., at the Royal Institution, February 19, 1886.